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FUTURE STRATEGIES FOR BOTANICAL EXPLORATION IN INDIA

S. K. JAIN

Botanical Survey of India, Howrah

Ever since the publication of the Hooker's Flora of British India (1872-1897), there had been very little plant exploration in our country till the middle of this century. Though a large number of regional floras were published in first quarter or early part of the present century, it is evident that most of them were based on the collections which were available also to the various collaborators of Hooker's work.

Therefore, there were not many additions in the regional floras published after Hooker. No doubt these regional floras such as the Flora of Bombay Presidency by Cooke (1901-1908), of Upper Gangetic Plains by Duthie (1903-1922), of Madras Presidency by Gamble (1915-1936), of Bihar and Orissa by Haines (1921-1925), of Bengal by Prain (1903) and of Assam by Kanjilal (1934-1940) have elaborate descriptions and sometimes better and detailed distribution of species, but have few additional species. During the first half of this century, only occasional collection tours were undertaken by botanists from Forest Research Institute, Dehra Dun, and of the Botanic Garden, Calcutta. Teaching in plant taxonomy or specialisation in plant taxonomy at postgraduate level, particularly doctoral research were confined only to one or two places in the country, such as at Bombay under the guidance of late Dr. H. Santapau. This lack of enthusiasm in intensive work on floristics and taxonomy retarded the findings of new records and new taxa or improvement in description or distribution of the known taxa. This resulted almost in a closed situation regarding the taxonomic and nomenclatural revisions of various genera in our country. Jain & Rao (1977) have recently reviewed the status of floristic studies in different parts of India.

Due to the close relationship of floristics and taxonomy on the one hand and laboratory and experimental research in botany (such as cytology, palynology, plant chemistry, pharmacognosy, plant physiology, horticulture, etc.) on the other, the various kinds of botanical field work can be broadly divided into 2 categories—(i) general botanical collections and (ii) special purpose collections.

Considering the present position of floristic accounts available in the country, development of national and regional herbaria and the materials available for special studies, our future botanical exploration activity has to include both the types of field work mentioned above.

Our general botanical collections have to be confined to those selected areas in the country for which no floristic accounts are available, or where no botanical collections have been made so far, for our herbaria.

The general collections must be preceded by careful scrutiny of the existing literature (including bibliographies on botany) in order to decide the priorities of areas. Further, the purpose of the general collection should be defined. That is, it will be profitable for the botanists making general collection in selected areas, to decide in advance, whether a detailed flora of the region is contemplated, or the collections are merely for enriching as well as filling up the gaps in the herbaria.

In deciding the areas of priority, one has also to keep in mind those areas which, by previous or recent experience are rich in new taxa.

The main emphasis in our future exploration work has to be on special purpose collections; this aspect is elaborated in the following paragraphs :

Currently, there is great awareness in our country for conservation of environment, threatened habitats, rare and endangered plants and endemic taxa, and establishment of biosphere reserves in various ecosystems.

For special purpose botanical field work. it should be determined in advance which of the above aspects will be the main concern of the scientist as this would decide the planning and execution of the field work. The field work which is concentrated on conservation of ecosystem or establishment of biospheres will necessitate the participation of taxonomists and ecologists reasonably familiar with the flora of the region.

Field work for evaluating the status of threatened plants and of endemics will necessitate thorough preparatory work for locating the areas of occurrence of the known and unknown or probable new localities of rare and endemic species. It is only after such satisfactory preparatory work that field work for assessment of habitats or rare plants will be profitable.

Another special purpose collection has to be for germ-plasm collections of selected groups, particularly of the economically more significant plants. For this too, considerable preparatory work would be necessary to decide areas of work with good probability of collecting the wild relatives of known economic plants. Building up satisfactory germ-plasm banks of living plants, seeds or other propagating materials depends greatly on proper planning of field work.

Special purpose collections would also be necessary for studies on cytology, anatomy, palynology, plant chemistry, ethnobotany and economic botany. Cytologists have to prepare census of plants which have not been studied cytologically and plan collection of materials from specific areas to fill the gaps in their collections of pickled materials or living plants. The same would apply to studies in palynology, anatomy etc.

For phyto-chemical survey, the field work could be combined with certain general collections. But botanists making collections for such purpose would have to know the requirements of conditions in which the plant material should be collected.

Researches in horticulture require material of living plants for building up collections of various varieties and for this purpose also explorations have to be specifically purpose-oriented.

Another aspect of botanical exploration is the precise data on the distribution and abundance of species. Eventually, most of the floristic activity has to be aimed at supply of data for plant-based industries and hence some kind of quantification is desirable. Ecologists will do well to devise some means of evaluating the quantity of economic products from mixed or pure populations of plants, While doing botanical collections in future. special care has to be taken of our threatened species. Many botanical curiosities like the pitcher plant (*Nepenthes khasiana* Hook. f.), other insectivorous plants like species of *Drosera* and *Utricularia,* plants of special morphological significance such as *Gnetum* spp. are often collected by students and botanical supply houses from wild populations. For many of these rare plants, wild populations at some places are already at the point of extinction. Such species should preferably be collected only in living condition and in small quantities. This too should be done not so much for preparing herbarium or museum specimens as for cultivating them in botanical gardens, so as the species could multiply and ensure on the one hand its survival in at least artificial conditions and on the other supply of its specimens for research and education.

Concern for control of such collection work has been felt in many countries and voiced in international conferences. Recently the Conference on Conservation held at Kew (12th to 17th Sept. 1978) decided that guidelines should be prepared for botanical collection work in case of rare species.

There is another area in which the special purpose collection will have to be considered seriously in future. This is the study of living plants (and plant-populations) in nature for proper evaluation of their morphological characters and habit with special reference to their taxonomy.

We have often witnessed foreign scientists specializing in certain families or genera, visiting India for collection of plants. Due to several limitations, particularly finance, such special purpose field work is practically non-existent for workers in India.

It is necessary that after the scientists involved in intensive taxonomic study of any group have familiarized themselves with the literature, herbarium materials and the phytogeography of the group, they get an opportunity of studying their plants in population or in associations in field. Means have to be found either exclusively for such special collection trips or at least by combining such field work with other general or special collections.

Some home work for scientists working in different herbaria of our country could be suggested in this regard. They can examine the holdings in their herbaria *vis-a-vis* flora of their state or district and list the taxa reported in literature but not present in their herbaria. They should sort out these lists according to the areas of work and concentrate on collections in such areas so as to fill the gaps in the herbaria. This would either result in successful collections and filling the gaps or result in a suggestion of possible rarity or even the extinction of the species in that area. Such data would be a very useful contribution in the evaluation of conservation status of various taxa in our country.

The Botanical Survey of India in collaboration with various other institutes has already prepared and circulated a tentative list of rare and endangered species of India. Curators of herbaria could compare their holdings also with these lists and find the status of chronological collections of these taxa.

Another question which is related to rare and endangered species is the 'why' of the phenomena of threatened species. Why certain species grow as wides while others are endemic and why certain populations tend to shrink and eventually become extinct. Is it that biotic factors or natural calamities always account for them or does biology of the species itself design its decline? Ecologists working on population biology or aut-ecology would perhaps ask field botanists for data for analysis in this respect, Based on his long experience, a field botanist may have to opine on the size of the population that can be said to be the minimum for its healthy survival and reproduction. If the collaboration of some zoologist can be available, information on the relationship of insect or bird fauna with reproductive cycle or rare species should be a very useful line of study. The importance of such studies in future in evaluation of ecosystems or conservation of biosphere cannot be overemphasized.

The problem of study, collection and evaluation of endemics in our country is very vast compared with many other countries. The work of Chatterjee (1940) remains so far the only significant work on endemism in India. This work dealt with Dicotyledonous plants and practically no work has been done on the Monocotyledonous plants. This lacuna needs to be filled through future explorations and studies. There are some difficulties in the studies on endemism of our country. This relates to absence of adequate literature on not only some parts of our own country, but also several regions adjacent to our country. After the publication of Flora of British India which included the regions of present Pakistan, Sri Lanka, Burma and parts of Tibet, only recently some floristic accounts have been published for Pakistan and Sri Lanka. No recent work is available for Burma and Tibet. Hence the correct picture of endemism of many of the taxa is rather difficult to assess. However, this should not deter our efforts in assessment of the taxa so far considered endemic. We have to lay special attention on these taxa during field work, particularly general collections, to widen their distribution within the country.

The role of students in future botanical exploration needs a special mention. Botany is taught at several levels in colleges and universities and very often collection of specimens, their preservation and preparation of a herbarium forms a part of evaluation in examinations. Presently, in most cases, the students pick up specimens at random, not unoften from the Botanic Garden attached with the Department or from immediate neighbourhood and submit for their examinations. Some students procure specimens from far off places and submit. Several students submit same plants year after year. With some careful planning, the faculty member teaching taxonomy, can assign different groups of plants to different students, such as a few families of Polypetalae to one, of Gamopetalae to another, the Monocots to the third, the Gymnosperms to the fourth and Ferns to the fifth, and so on. These groups could be further divided according to convenience. Some general instructions on the local flora could be given. Thereafter the students could collect specimens of the assigned group only. This would result in intensive search and careful identification, thereby leading to building up good small herbaria of the local flora in educational institutions.

The students of higher classes should make this work still more critical by preparing descriptions and keys of their groups which would eventually help in preparation of flora of the university town or the district. The exposure of students to nature and flora would create in them an interest and awareness of local plant resources. Repeated intensive collections for several years could also provide data on relative abundance or rarity of species and hence an insight into need for conservation of selected taxa.

In the context of future strategies in botanical exploration it is relevant to briefly touch upon the availability of scientists trained in floristics and plant taxonomy and the programme of the Survey on publication of floras. The lack of taxonomic activity in the country in the first half of present century resulted in absence or acute shortage of persons trained in taxonomy. This serious lacuna became evident when the Botanical Survey was reorganised about 25 years ago. The Deptt. could recruit at that time about 10 suitable scientists with difficulty. Over the course of 20 years many scientists who joined the Survey as non-taxonomists, acquired adequate expertise. By expertise in plant taxonomy or floristics, the author means a few particular areas *viz.* experience in independently planning and undertaking botanical explorations, identification, practice in applition of rules of nomenclature, familiarity with Indian and world literature on floristics and monographs, herbarium methods and in taxonomic revisions. There are scientists who have made intensive collections, identifications and enumerations, but often they do not get the insight into critical appraisal of morphological characters, evaluation of such characters, the problem of synonymy and nomenclature. The training and research in floristics or plant taxonomy is undertaken only at a few centres outside the B.S.I., in our country. And everytime when the Survey wants to recruit scientists at higher or middle levels, fresh blood is scarcely available. So, within the B.S.I. the expertise which the scientists have acquired, is primarily by self-learning or working with more experienced scientists.*

Botanists who have experience in this kind of critical study into morphological characters, nomenclature and synonymy are only a few in the Survey and in the country. But, it is such specialists who can be expected to be involved in writing the long awaited new Flora of India.

It may be mentioned here incidentally that the new Flora of India or the National Flora which is under preparation,** will be a semi-revisionary work. It will be very different from a flora of a district or a town because it will deal with all the taxa occurring in India. All material available in herbaria of our country and the literature on the subject not only in India but monographs or revisions published elsewhere also will be examined and then only the account of the genera or families will be prepared. It is common knowledge that it is not done in most cases while writing local floras of towns or districts.

For several reasons it has also been planned to bring out floras of districts or small interesting botanical areas. Through these, manuals will become available to students for study and identification of plants, and to plant-based industries for evaluation of the plant resources with which their industries are related. Emphasis is being laid on those districts which are backward or less known and where there is urgent need to provide subsidiary income or employment to rural populations through plant resources. For the benefit of larger groups of scientists there are plans simultaneously for bringing out enumerations of plants occurring in different states of our country. These are being named as State Flora Analysis because these enumerations will not be mere lists of species but will have information on economic uses, phytogeographical importance and some related data.

The Botanical Survey of India is presently the main institution devoted to exploration of the plant wealth. It has already planned its future survey activities in the light of the above discussions and the general collections by scientists in our regional offices are confined to unexplored areas or areas likely to yield results of interest for conservation or economic utilisation.

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[*] Plans have been drawn to train some youngmen in the Deptt. or outside at least through short courses. One such course was conducted in Calcutta in Mar.-Apr. 1978.

[**] One fascicle published in October 1978, another in May 1979.

The functions of the B.S.I. clearly lay down the close relationship between the botanical exploration and utilisation of plant resources and hence collections simply for the sake of collections and preparation of herbaria have been kept as a low priority.

It is relevant to mention here for appreciation by the scientists in the B.S.I. that an adequate exploration and knowledge of the flora of our country is primarily the responsibility of this Department. Most of the other scientists doing botanical explorations do these as their secondary activity, their primary function being teaching or research in some other area. By well-planned and well-accomplished botanical explorations the scientists of the Survey can prove that the field botanists or the plant taxonomists do not play the second fiddle to any other discipline of botany. Botanical exploration work has its well-defined aims and objectives which by all means are of as much national relevance and importance as any other science of today or future. And, it has its adequate rewards too.

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